However, the Examiner has rejected claims 1, 5, 9, 45, 49, 93 and 97 under 35 U.S.C. § 103(a) as being unpatentable over Applicant's Admitted Prior Art, and in particular over JP 2001-266723 ("JP '723"). Regarding claims 1 and 5, the Examiner argues that Applicants disclose that a fuse element having an alloy composition of 42 to 53% In, 40 to 46% Sn, and 7 to 12% Bi was known in the fuse art, which the Examiner contends overlaps the claimed composition. Therefore, the Examiner concludes that it would have been obvious to one having ordinary skill in the art at the time of the invention to select the claimed ranges for ternary In-Sn-Bi alloys based on the teaching of the prior art. Regarding claims 9, 45, 49, 93 and 97, the Examiner argues that the fuse element of JP '723 would inherently contain inevitable impurities, and that JP '723 teaches a heating element disposed on the substrate and a fuse element connected between a pair of lead connectors and sandwiched between insulative films.

The Examiner has also rejected claims 37, 41, 77, 81 under 35 U.S.C. § 103(a) as being unpatentable over JP '723 in view of U.S. Patent No. 4,496,475 of Abrams ("Abrams"). The Examiner argues that JP '723 discloses that the thermal fuse has film electrodes formed on a substrate, in which the electrodes are made of a conductive paste comprising silver. The Examiner acknowledges that JP '723 does not disclose that the paste comprises a binder and silver particles. However, Abrams allegedly teaches a conductive paste comprising silver particles and a binder, in which the paste is useful for forming conductive bodies on a substrate while maintaining favorable properties and reduced production costs. Therefore, the Examiner concludes that it would have been obvious to one having ordinary skill in the art at the time of the invention to use a conductive paste as taught by Abrams for forming electrodes of JP '723 in order to enhance electrical and mechanical properties of the electrodes and to reduce production costs. Applicants respectfully traverse these rejections and the arguments in support thereof as follows, and respectfully request reconsideration and withdrawal of the rejections.

At the outset, it appears from the Examiners comments that the reference which forms the basis for the rejection is JP 2001-266**724**, not JP 2001-266**723**. Correction on the record is respectfully requested.

Materials for thermal fuse elements and thermal fuses which contain ternary alloys are characterized by the relative proportions of all three elemental components since the properties of these materials are determined by all three components. The concentrations of only two elements, In and Sn, in the claimed alloy composition overlap with the amounts in JP '724; the

amount of Bi does not overlap. As shown in the liquidus phase diagram of a ternary Sn-In-Bi alloy attached hereto as Appendix 1, the claimed alloy composition and the alloy composition of JP '724 do not overlap but rather are adjacent to one another. Therefore, it would not be expected from JP '724 that that the properties exhibited by the claimed alloy, which result from the claimed specific proportions of all three alloy components, would result. It is only when all three elements are present in the appropriate concentrations that the objectives and effects of the present invention are achieved; properties which would not be observed by the alloys according to JP '724.

The claimed alloy composition has been developed by Applicants after extensive experimental research, and such an alloy composition would not be suggested by JP '724 as follows. Applicants have performed a differential scanning calorimetry (DSC) analysis over a wide region around a binary eutectic curve C, namely, a binary eutectic curve $24 \leq Sn \leq 47$; $0 \leq Bi \leq 28$; $47 \leq In \leq 50$ which elongates from the Sn-In binary eutectic point P1 (48% Sn, 52% In) of the Sn-Bi-In alloy toward the Sn-Bi-In ternary eutectic point P2 (21% Sn, 31% Bi, 48% In). These points on the curve C are shown in Appendices 1 and 2 attached hereto. As a result of this analysis, Applicants observed four different melting characteristic patterns which are determined by the relative proportions of the three alloy components. The four melting patterns are shown in diagrams (A) to (D) of Fig. 11 of the application and are attached hereto as Appendix 3 for convenience.

Melt pattern (A), corresponding to a region which is separated from the binary eutectic curve, contains $25 < Sn \leq 60$, $12 < Bi \leq 33$ and $20 \leq In < 45$, and is encompassed by the present invention (see Appendix 2). As shown in Appendix 3, melt pattern A exhibits a single maximum endothermic peak P between the solidus temperature a and the liquidus temperature b (the solid-liquid coexisting region). When a Bi-Sn-In alloy having this melting pattern is used as a fuse element, the fuse element can be concentrically fused off in the vicinity of the maximum endothermic peak. Additionally, such a fuse element provides excellent overload and dielectric breakdown characteristics. Melt pattern (A) results when the solid-liquid coexisting region between a and b is wide, because it is in a region which is separated from the binary eutectic curve, and the fuse element can be concentrically melted.

Melt pattern (B) corresponds to a region which includes the binary eutectic curve and contains $25 < Sn \leq 43$, $12 < Bi \leq 30$, and $45 \leq In < 50$, which is also encompassed by the present

invention (see Appendix 2). As shown in the diagram in Appendix 3, in such a region, the solid-liquid coexistence region is so narrow that the solidus temperature a and the liquidus temperature b coincide with each other. Although it would be expected to be impossible to concentrically fuse off the fuse element in such a region, Applicants found that when a Bi-Sn-In alloy having this melting pattern is used as a fuse element, the fuse element can be concentrically fused off in the narrow solid-liquid coexisting region. Melt pattern (B) results when a solid-liquid coexisting region between a and b is narrow because it is close to or includes the binary eutectic curve, and the fuse element can be concentrically melted.

As explained in the Background section of the application, alloys which have narrow solid-liquid coexisting regions between the solidus and liquidus temperatures are typically used in fuses. Eutectic compositions are ideally used so that the fuse element is fused off at approximately the liquidus temperature (which is equivalent to the solidus temperature in a eutectic composition). In a fuse element having an alloy composition in which there is a solid-liquid coexisting region, there is the possibility that the fuse element may be fused off at an uncertain temperature within this region. When the solid-liquid coexisting region is wide, this uncertain temperature width becomes large, and the operating temperature of the fuse becomes widely dispersed. Therefore, in order to reduce this dispersion, alloy compositions having narrow solid-liquid coexisting regions, and more preferably eutectic compositions, are typically utilized.

However, Applicants were surprised to discover that even when a fuse element is prepared from an alloy which falls in a region which has a wide solid-liquid coexisting region (corresponding to melt pattern (A)), the resulting fuse element can be concentrically fused off in the vicinity of the maximum endothermic peak. Thus, the alloy composition corresponding to melt pattern (A) provides unexpected properties.

Melt patterns (C) and (D) correspond to a region having > 60% Sn, < 20% In, and > 33% Bi, which is not encompassed by the present invention. As shown in Appendix 3, in melt pattern (C), the heat energy is slowly absorbed and the wettability is not abruptly changed. When a Bi-Sn-In alloy having this melting pattern is used as a fuse element, the fuse element cannot be concentrically fused off. Melt pattern (C) results when a solid-liquid coexistence region between a and b is wide, and the fuse element cannot be concentrically melted.

Finally, in melt pattern (D), there are several endothermic peaks. At any one of the endothermic peaks, a division operation of the fuse element may occur. Thus, when a Bi-Sn-In alloy having this melting pattern is used as a fuse element, the fuse element cannot be concentrically fused off. Melt pattern (D) results when a solid-liquid coexisting region between a and b is wide, there are several concentric melting points and the fuse element cannot be concentrically melted at one point.

As a result of these DSC studies, Applicants concluded that in order to ensure that the fuse element can be concentrically fused off at one point, regardless of the width of the solid-liquid coexisting region, it is necessary to utilize the claimed alloy composition in the thermal fuse. Thus, Applicants have determined that the claimed alloy composition containing $25 < Sn \leq 60$, $12 < Bi \leq 33$, and $20 \leq In < 50$ provides the desired properties. Such an alloy exhibits the melt characteristics of patterns (A) or (B) and excludes the characteristics of patterns (C) and (D).

The alloy of JP '724 is different from and does not overlap with the claimed alloy composition. Further, JP '724 does not teach or suggest an alloy composition which ensures that the fuse element can be concentrically fused off at one point, regardless of the width of the solid-liquid coexisting region. Therefore, the claimed invention would not have been obvious based on JP '724. Further, since Abrams also does not teach or suggest the claimed alloy composition nor these properties, Abrams does not cure the deficiencies with JP '724, and even the proposed combination would not suggest the present invention. Accordingly, reconsideration and withdrawal of the § 103(a) rejections are respectfully requested.

Based on the preceding Remarks, it is respectfully submitted that the present claims are patentably distinct from the prior art of record and in condition for allowance. A Notice of Allowance is respectfully requested.

Respectfully submitted,

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Encl: Appendices 1, 2, and 3